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Bamboo Mosaic

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Bamboos have a wide range of societal and industrial uses as food, building material, high-quality paper, and soil conservation. In Hawai'i, bamboos are popular landscape plants whose cultivation is supported by a growing potted bamboo industry. Bamboos normally require little maintenance and may live for decades with little care. In some cases, however, insect pests and plant diseases can significantly diminish bamboo growth and reduce the plants' aesthetic and economic value.

In 1977, bamboo plants in Brazil were reported to be infected with a new virus, *Bamboo mosaic virus* (BaMV). The disease, bamboo mosaic, was also found in Taiwan in 1993 (Lin et al. 1993) and in the mainland United States in 1995 (Lin et al. 1995). Bamboo mosaic disease also poses a widespread threat to bamboo in Hawai'i. It is unclear when BaMV first arrived in Hawai'i, but a mosaic virus was reported on *Bambusa vulgaris* and *Bambusa* sp. in Hawai'i in 1960 (USDA 1960).

During the 1990s, bamboo plants (*B. vulgaris*) in the bamboo courtyard at the Department of Art and Art History at the University of Hawai'i-Mānoa campus developed mosaic symptoms. As bamboo mosaic virus is mechanically transmitted, the disease was probably spread among plants by tools used in pruning. Since then, the bamboo stands at this location have declined in vigor, the plants becoming thinner and growing less vigorously. Electron microscopy of leaves revealed virus-like particles with shapes typical for members of the *Potexvirus* genus. A reverse-transcription polymerase chain reaction (PCR) assay for potexviruses (van der Vlugt and Berendsen 2002) using RNA isolated from leaf tissues as a template indicated the presence of a potexvirus in symptomatic plants. Subsequent cloning and sequencing of the PCR products confirmed the presence of BaMV in the symptomatic bamboo plants.

Bamboo infected with *Bamboo mosaic virus* growing at the Department of Art and Art History, University of Hawai'i-Mānoa campus. The plants have been heavily pruned over the years, which may have resulted in transmission of the virus.

Here we describe the symptoms of bamboo mosaic, the viral pathogen, and integrated management practices that can effectively reduce disease occurrence.

Pathogen description, host range, and geographic distribution

Bamboo mosaic virus is a plant pathogenic virus in the genus *Potexvirus* within the family *Flexiviridae*. BaMV virus particles are filamentous, flexuous rods,

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490 nm long and 15 nm wide. The genome of BaMV is a monopartite positive-sense single-stranded RNA. The natural host of BaMV is bamboo, of which at least 10 different species are susceptible (Lin et al. 1993). Other plant families that have susceptible hosts include *Amaranthaceae*, *Chenopodiaceae*, and *Poaceae*. BaMV occurs in Hawai'i and among the Pacific Islands, Australia (Dodman and Thomas 1999), the Philippines, Taiwan, Brazil (Brunt et al. 1996), and the United States (e.g., Elliot and Zettler 1996).

Virus transmission and disease symptoms

No insect vector is known to transmit BaMV. The virus is spread readily by mechanical inoculation, which can occur easily from contaminated tools used for propagation or harvesting. Disease symptoms include chlorotic mottling and mosaic patterns parallel to the leaf veins, necrotic streaks on shoots and culms, vascular discoloration, aborted stems, and plant death. Some susceptible hosts may not display any symptoms.

Disease diagnosis

Disease diagnosis can be confirmed by PCR (polymerase chain reaction), ELISA (enzyme-linked immunosorbent assay), inoculation of assay hosts, and/or symptom expression. This is the only known mosaic disease of bamboo. The sequence for BaMV is available in GenBank, and PCR primers for virus detection are available. Alternatively, samples can be submitted to Agdia (www.agdia.com), which uses PCR to detect viruses in the *Potexvirus* genus.

Table 1. Bamboo hosts for *Bamboo mosaic virus*.

Bambusa	Dendrocalamus
B. beecheyana	*D. latiflorus*
B. beecheyana cv. *pubescens*	*D. latiflorus* cv. 'Mei-nung'
B. edulis	
B. multiplex	**Phyllostachys**
B. oldhamii	*P. nigra*
B. vulgaris	
B. vulgaris var. *striata*	

Disease management

Once established, the disease cannot be eradicated without destroying the infected plants. Use the following disease-management practices to prevent infection with and spread of the disease.

- Do not purchase, distribute, or plant BaMV-infected bamboo plants with mosaic symptoms on leaves. Test susceptible species for BaMV before planting them.
- Avoid pruning a diseased plant, or sterilize pruning blades with heat between cuts. Note that some infected plants may display only mild or subtle symptoms.
- Purchase BaMV-free plants produced by meristem tip culture.

Typical symptoms of bamboo mosaic on *Bambusa vulgaris* caused by *Bamboo mosaic virus* (BaMV) include distinctive interveinal chlorotic mosaic patterns and striping on the leaf surfaces. Photograph taken at the Department of Art and Art History, University of Hawai'i-Mānoa campus.

Table 2. Selected plants and their susceptibility or reaction to inoculation with *Bamboo mosaic virus* (BaMV)[1]

Diagnostically susceptible host species	Diagnostically resistant host species	Assay hosts: local lesions (L) or whole plants (W)
Gomphrena globosa	*Phaseolus vulgaris*	*Gomphrena globosa* (L)
Chenopodium amaranticolor (necrotic local lesions; not systemic)	*Capsicum annuum*	*Chenopodium amaranticolor* (L)
Bambusa vulgaris 'Vittata'	*Lycopersicon esculentum*	*Bambusa vulgaris* 'Vittata' (W)
Dendrocalamus latiflorus cv. 'Mei-nung' (systemic mosaic)	*Nicotiana tabacum* 'Turkish'	*Dendrocalamus latiflorus* cv. 'Mei-nung' (W)
	Oryza sativa	

[1](Brunt et al. 1996)

Symptoms of bamboo mosaic on *Bambusa vulgaris* caused by *Bamboo mosaic virus* (BaMV): interveinal chlorosis and striping along leaf veins. Photograph taken at the Department of Art and Art History, University of Hawai'i-Mānoa campus.

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